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BULLETIN

OF THE

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Vol. 45 No. 9

BULLETIN

OF THE

TORREY BOTANICAL CLUB

SEPTEMBER, 1918

Wound periderm in certain cacti

MARY WOTHERSPOON COUTANT

(WITH PLATE 9 AND THREE TEXT FIGURES)

NORMAL TISSUE

The two cacti upon which the work of this paper is based are *Opuntia versicolor* Engelmann and *O. discata* Griffiths. These are jointed, branching forms, characteristic of the flora in the vicinity of Tucson, Arizona. Morphologically they differ in that the joints of the *O. versicolor* are composed of fluted cylinders, while those of the *O. discata* are more or less disc-shaped. Necessarily, a cross section of the former presents the appearance of a circle with an undulating margin, while one of the latter is more of an elongated ellipse. Anatomically considered, they are identical in all essentials. There is (1) a distinct pith in the center, bounded (2) by a ring of bundles equidistant from the exterior; outward from the bundles (3) a ring of cortical tissue, which extends to the (4) hypoderm, outside of which is the (5) epidermis. Subepidermally, in plants several years old, normal periderm occasionally, but not typically, forms in isolated areas.

Schleiden (3), in his early work on the cacti, describes fairly accurately several forms, which, however, do not include either *O. versicolor* or *O. discata*.

A further discussion of the tissues in their normal condition is prerequisite to a complete understanding of their behavior as a result of wounding.

[The BULLETIN for August (45: 309–352) was issued September 9, 1918.]

The pith is composed of thin-walled, isodiametric cells, loosely packed together, and with consequent large intercellular spaces. The cells themselves contain, aside from the usual protoplasmic contents, a considerable quantity of stored starch, and small crystals of calcium oxalate. These crystals are found in large quantities in practically all of the tissues of both opuntias, sometimes causing, parallel with their own growth, an hypertrophy of the cells containing them. In a concentrated solution of hydrochloric acid, the calcium oxalate of a medium-sized crystal does not dissolve for over half an hour. Lauterbach (**2**) describes these crystals as being star-shaped clusters composed of monoclinic prisms, which have a short principal axis, and states that they make up 85 per cent. of the weight of the ash.

The bundles vary somewhat in their structure with the age of the plant and their position in the stem. Essentially, they are of the open collateral type, with hadrome and leptome on the same radius, separated by a cambial layer. The hadrome, much greater in extent than the leptome, consists of annular and spiral ducts, occasional parenchyma cells, and, in many cases, large interspersed masses of stereome tissue. The ducts and stereome cells are lignified, as shown by testing with phloroglucin and hydrochloric acid, and in cross section the latter greatly resemble the median optical view of the lignified-walled cells, to be described later in the formation of the periderm. The cells of the cambial region, as seen in cross section, present the typical brick-shaped appearance, and form, at the most, a layer not more than three or four cells deep. The leptome is composed of the characteristic sieve tubes and their accompanying companion cells, interspersed with parenchyma tissue. In cross section the peripheral portion of the leptome mass appears dome-shaped, and is capped by a mass of collenchymatic cells which resemble those of the hypoderm, referred to later on. The walls of these cells often become more or less mucilaginous, an occurrence similar to that found by Lauterbach (**2**, p. 262) in *Pereskia*, also one of the Cactaceae. The subcortical cells in the bundle region appear isodiametric, like those of the pith. However, there is a gradual merging of these cells with those in the outer cortical region, which are distinctly cylindrical and arranged end on end, with their long axes at right

angles to the periphery. The outer five or six rows are normally rich in chloroplasts, and practically all of the cortical tissues contain a plentiful supply of stored starch. In seedlings a single-layered epidermis covers the distinctly parenchymatic cortical cells. However, as the plant matures, the outer cortex gives rise to a clearly differentiated tissue, the hypoderm, socalled by Solereder in his Systematic Anatomy of the Dicotyledons (**4**). The cells of the hypoderm are, in both opuntias here studied, from five to seven layers in depth, and decidedly collenchymatous in character. Schleiden (**3**, p. 348) describes this condition as arising through loss of water, from cells originally mucilaginous. PLATE 9, FIG. 1 will serve to give an idea of the thick cellulose walls, traversed by pit canals which radiate out from the comparatively small lumina, indicating protoplasmic continuity between the cell contents. The outer layer, which lies just underneath the epidermis, is characteristically so filled with oxalate crystals as to almost obliterate the walls. Occasional crystals are found in the other cells. This tissue has been described for different species of *Opuntia* by Lauterbach (**2**, pp. 259–264), as well as by the two authors mentioned above.

The epidermis is a single layer of cells in thickness and covered thickly with cutin, as shown by staining with Sudan III and heating. The stomatal openings extend through the hypodermal tissue down to the cortical cells. The guard cells are somewhat sunken, and the whole cavity is lined with cutin continuous with that on the outside. This fact was brought out by Mohl (see Solereder, **4**, p. 408) in his work on the cacti.

The normal periderm, mentioned in the introduction as forming in plants several years old, arises superficially, and gives the appearance of circular markings on the surface. When examined in a transverse section of the stem, it is seen to be composed of alternating zones of thin- and thick-walled tissue, each zone being itself several layers of cells in thickness (PLATE 9, FIG. 6). The thin-walled cells appear brick-shaped, and superficially greatly resemble meristematic tissue, except that their walls are highly suberized. The thick-walled cells are, on the contrary, lignified, reacting with phloroglucin and hydrochloric acid as did the stereome mentioned in discussing the structure of the bundles.

A single layer of this lignified tissue is never deeper than three cells, arranged one on top of another; the outer tangential and the radial walls are thicker than the inner tangential ones, and in consequence the peripheral portions of the lumina are dome-shaped, as is so common in thickened cutinized tissue of the epidermis. In very thin sections stained with Bismarck brown, distinct striations can be seen in the walls, coarser near the lumen, and becoming finer toward the exterior; while running at right angles to these striations are numerous fine pores. PLATE 9, FIG. 5, gives an optical transverse view of this tissue. The middle lamellae are shown, but the striations and pits above referred to are not indicated. In describing the origin of this particular tissue, Schleiden (3, p. 352) says that there arises a thick, yellow-brown, granular, slimy mass, in which eventually cells are formed. At present such an hypothesis is not to be accepted. However, although omitting any reference to lignification, he brings out clearly the fact that in the mature periderm there are alternating zones of suberized thin- and thick-walled tissue.

EFFECT OF WOUNDING ON NORMAL TISSUE

Having studied the normal tissues, with especial reference to the periderm, the next problem was to find out what reactions would follow as a result of injury. Wounds were brought about by making longitudinal slits down the plants with a razor, usually cutting deeper than the bundle ring, but never beyond the center of the pith. A contraction of the cells near the cut surface resulted, thereby opening up the wound, and exposing the tissue to the air. After the elapse of definite periods this material was placed in alcohol. Some stems were wounded with glass, in order to avoid a possible stimulus which might result from the acids of the tissues acting on the steel of the razor, and the resultant formation of soluble iron salts. In running a parallel series, however, there was found to be no difference in the rate of wound reaction between the two, so the use of the razor was adhered to.

All of the material used came originally from Tucson, Arizona. In the spring of 1913, cuttings were sent from Tucson, which were immediately wounded and killed, but gave unsatisfatory results. Plants from Tucson were wounded while growing in the Barnard

College greenhouse, but, although giving fairly good results, they were by no means as dependable as those obtained from material wounded and killed directly in its natural habitat in Tucson. Material of this character, collected by Dr. H. M. Richards in 1911 and by Dr. D. T. MacDougal in 1914, serves as the basis for the observations which follow.

Practically all of the studies have been made from transverse sections through the stems, where, owing to the above mentioned opening of the wound, the two exposed surfaces form a "V." Hand sections stained with Bismarck brown served to show clearly all cell walls, and the unstained portions were easily tested for cutin, cellulose, lignin, etc. Although most of the figures were made from such hand sections, those cut with a microtome were used for reference.

The only visible change during the first day after wounding is the partial loss of starch in a region running parallel with the exposed surface of the wound, but not bordering directly upon it. By the second day, that region is entirely starchless, and the reaction with iodine of the starch in the cells on the wound surface does not give the normal purplish blue, but more of a reddish color, suggesting the presence of a greater proportion of erythrodextrin.

In three-day-old wounds, some of the oxalate crystals in the most exposed cells have increased in size. The starchless area in the upper part of the "V" has become divided into two practically equal parts, by the foreshadowing of a meristematic layer running parallel to the surface of the wound. The cells in the outer region, that is, between this future meristem and the cut surface, are somewhat discolored. The cells comprising this prospective wound-phellogen are one layer in depth, and although no divisions have as yet taken place, there seems to be an adjustment of the containing cytoplasm to form a flat plate, continuous from one cell to another, and parallel to the wound surface. PLATE 9, FIG. 2, will give an idea of how this appears in section.

A wound four days old shows the meristematic or phellogen layer more clearly, especially near the periphery, where the cells seem about to divide. Near the base of the cut, particularly if the wound is deep and the circulation of air slight, it is un-

developed, possibly due to lack of available oxygen or perhaps to the lessening of the transpiration. See TEXT FIG. 1. The latter is suggested by a fact mentioned by Küster (1, p. 187), that a preliminary condition for the production of wound-cork is that at least a small degree of transpiration must be possible for the exposed tissue. Here, as pointed out, the cells on the cut surface near the periphery must have at least a normal amount of transpiration, while those deep in the cut can have much less.

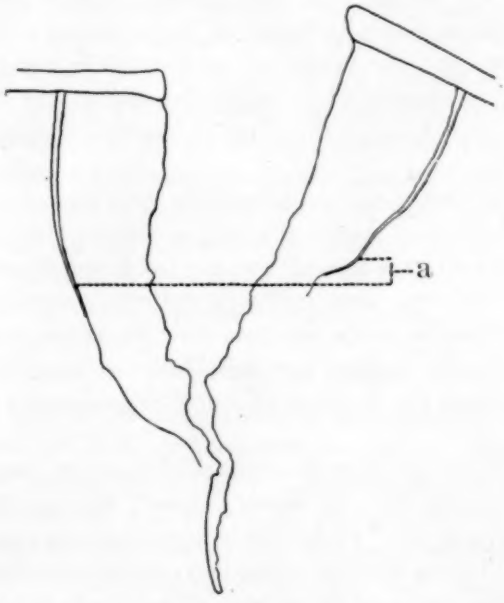

FIG. 1. Cross section of a four-day-old wound of an *Opuntia discata* plant, showing the characteristic V-shaped cut and the formation of the wound-phellogen only in the outer parts of the wound, × 28. *a*, phellogen layer.

Another change from the three-day-old wound is that the walls of the discolored cells nearest to and outside of the developing phellogen, have become lignified.

A study of a five-day-old wound can best be made by referring to TEXT FIG. 2. The phellogen is clearly distinguishable and has produced, except near the periphery, what may be spoken of as a distinct phellem. This phellem is about three cells deep, and the walls are highly suberized. The lignified cells just outside

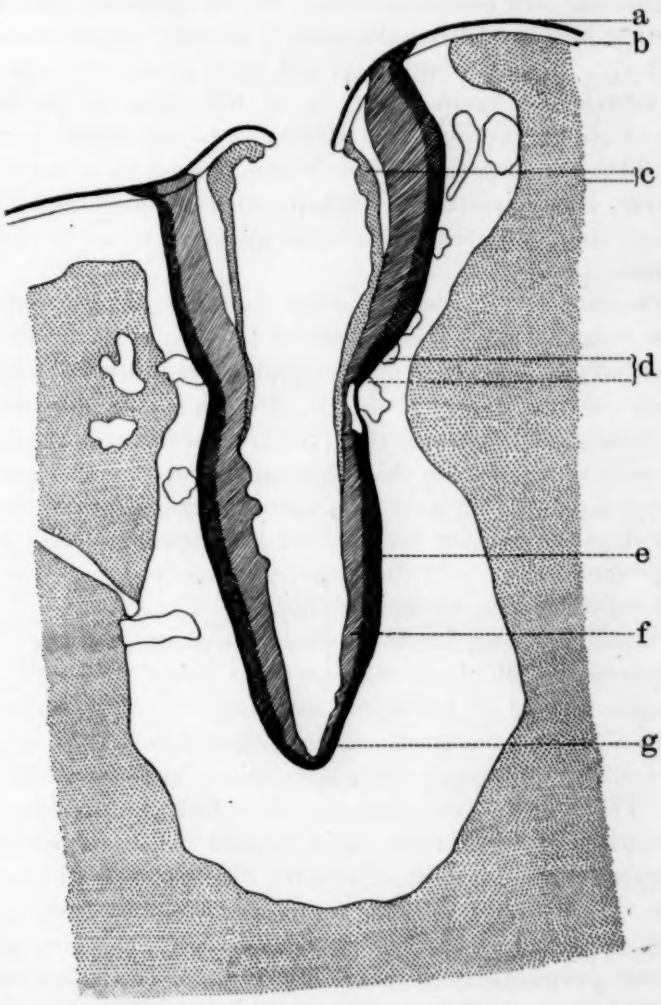

FIG. 2. Diagrammatic cross section through a five-day-old wound of an *Opuntia versicolor* plant, × 24; the open white areas consist of normal cellulose-walled cells; starch is found only in regions indicated. *a*, epidermal cells, with heavily cutinized outer walls; *b*, hypodermal tissue; *c*, cellulose-walled cells, containing stored starch; *d*, vascular bundles; *e*, cells, the walls of which have become discolored and lignified; *f*, cells, the walls of which have become discolored; *g*, suberized, thin-walled cells, produced through action of the first wound-meristem.

of them also give the suberin test, leaving, however, the large number of discolored cells unlignified, or giving the lignin test and no other. This phenomenon of cell walls giving the tests for both suberin and lignin Küster (1, p. 165) finds in the callus tissue of poplar cuttings. He says he does not doubt that the same substance, or a similar one, is the cause of these reactions. However, this statement is perhaps open to question. There seems no reason why both suberin and lignin might not be present together.

In wounds six and seven days old the phellogen has produced on the outside more suberized-walled phellem cells and on the inside what may be called a distinct phelloderm, the walls of which are pure cellulose (PLATE 9, FIG. 3). For the sake of convenience these tissues will be spoken of as phellem, phellogen and phelloderm, with the realization that, although analogous to the normal periderm of plants, they are not necessarily homologous. Although the phellem extends up through the hypoderm, few cells have been produced there. At this stage, still more of the cells in the discolored tissue have become lignified.

A wound ten days old shows several marked advances. The periderm is in all about eighteen cells deep. However, the phellogen, instead of producing only suberized phellem tissue, has given rise to a few thick-walled lignified cells, five or six in a cross section, appearing on one side, about half way down the "V." These cells were previously described in discussing the normal periderm. A further lignification of the discolored tissue is apparent. Another change is in the distribution of the stored starch. With the formation of waterproofing cells covering the wound, the normal activities of the tissues seem to be resumed, and small grains of storage starch appear in the phelloderm cells, and in the cortical cells below the phelloderm. These grains are, however, very few and very scattered.

The next wound studied in detail was twenty-four days old. Considering the various zones of tissues which extend from the wounded surface into the interior of the plant, we have (1) on the outside, the cells, in no way discolored, which retain the original stored starch they contained at the time of wounding. Some enclose oxalate crystals which have increased considerably in size.

Within is (2) the layer of discolored cells whose protoplasmic contents appears to have degenerated and the walls of which are

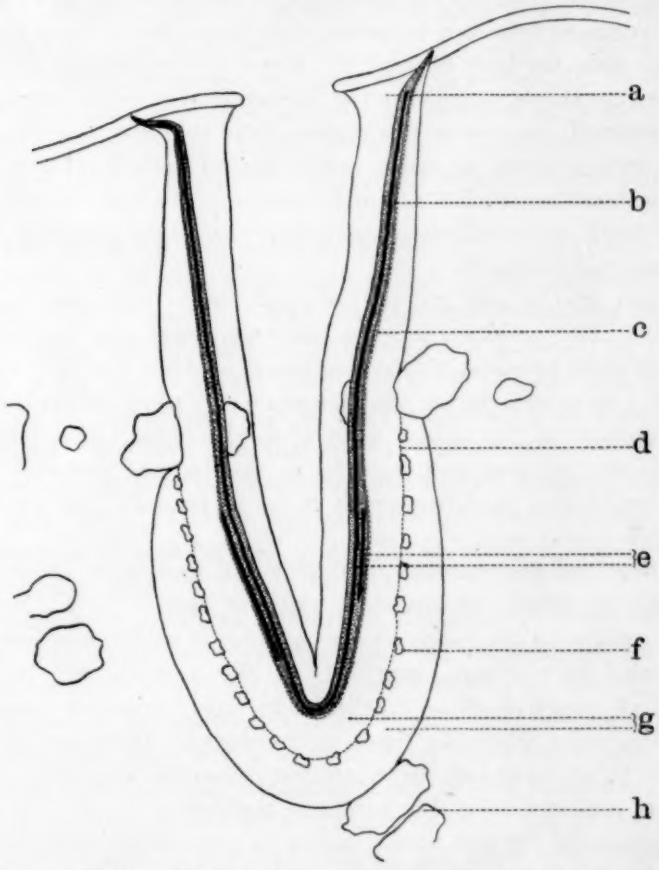

FIG. 3. Diagrammatic cross section through a thirty-one-day-old wound of an *Opuntia versicolor* plant. × 24. *a*, old tissue, bordering upon wound surface; very outermost cells are unchanged, others are discolored and their walls lignified; *b*, lignified thick-walled cells, produced by first wound-meristem; *c*, first wound-meristem; *d*, second wound-meristem; *e*, suberized thin-walled cells, produced by first wound-meristem; *f*, young vascular bundles produced by second wound-meristem; *g*, "phelloderm" tissue, produced by first and second wound-meristems, the cells being cellulose-walled, and containing small amounts of stored starch and oxalate crystals; *h*, old vascular bundles.

almost completely lignified. Bordering upon them is (3) the suberized phellem tissue, averaging four or five cells deep, below

which are (4) the thick-walled lignin cells, usually two, but occasionally three deep. Inside is (5) more suberized tissue, which arises directly from (6) the phellogen. The phelloderm (7) below this, averages from ten to twelve cells deep, but is considerably thicker near the base of the "V," where the appearance of some of the cells seems to indicate the formation of a second meristem. The walls of the cells in this region are of cellulose, and the contents include small, probably newly formed oxalate crystals, and a considerable quantity of stored starch. The cortical cells (8) underneath the phelloderm have now practically regained their normal starch content.

TEXT FIG. 3 will aid in the study of a thirty-one-day-old wound. The periderm is more developed, and now includes in certain areas two more alternating layers of thick- and thin-walled tissue. However, the big advance made here comes in the further development of the second layer of meristematic tissue forming within the old periderm, parallel to the exposed surface. The function of this meristem seems to be to produce new vascular bundles.

These bundles develop first near the innermost portion of the wound, where the meristem was first seen to form. Küster (1, p. 164), in his discussion on the histology of callus, mentions the formation of tracheids, especially in the inner layer. By the union of many of these tracheids, he says, primitive vascular bundles, and a wood-like tissue are produced. However, here in the cacti, we have not just scattered rudiments of bundles, but distinct masses arranged in a definite position.

Eventually the first wound-meristem extends peripherally into the hypodermal tissue, but not until it is elsewhere very well developed. Another point to be noticed is that where the bundles were cut through, or where they are merely in a line with the wound phellogen, their prosenchymatic as well as their parenchymatic cells seem capable of reverting to a meristematic condition. Whether the stereome and hadrome tissues are able to revert is possibly questionable, but in these wounds it does not look as if the meristematic cells adjoining them had arisen from parenchyma cells some distance away.

DISCUSSION AND CONCLUSIONS

The series of changes which take place after injury, as described in the different ages of the wounds, really gives in itself a summary of what reactions took place.

The disappearance of starch in certain cells of the cacti prior to normal cork formation, is noted by Sorauer (**5**, p. 428), so it is not surprising to find it here, prior to the development of wound periderm, which, as can be seen, greatly resembles that produced normally.

This latter fact was noted by Schleiden (**3**, p. 353) who states that the best analogy to the natural cork building process is seen in the effect of wounding, and that this can be observed nowhere so easily as among the cacti. He does not, however, go greatly into detail, but describes the "drying up" of the cells on the surface of the wound, due to the "evaporation of their liquid contents" and says that this layer of "dried out" cells forms a protection to the cells underneath, out of which is formed the cork. He also states that the wound formation does not take place exclusively in cells exposed to air, but in behalf of this, gives no convincing proof.

Küster (1, p. 186) in his work on the histology of wound-cork, says that the walls are always thin, and often folded, and that differentiation of any kind whatsoever is entirely absent. This, of course, is not the case in these cacti. The formation of the thick-walled lignin cells is in itself enough to disprove the fact.

The essential new facts brought out by this paper are (1) the lignification of the old outer cortical cells, (2) the production of both thin- and thick-walled cells by the activity of the wound phellogen, and (3) the formation of the second, interior meristematic layer, forming the new vascular bundles, parallel to the wound surface.

I wish to thank both Dr. D. T. MacDougal, of the Carnegie Desert Laboratory at Tucson, and Dr. H. M. Richards, of Barnard College, for their kindness in providing me with material, and to express my sincerest appreciation to Dr. Richards for the aid he has given me in my work.

BARNARD COLLEGE BOTANICAL LABORATORY,
COLUMBIA UNIVERSITY

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Explanation of plate 9

All figures are Zeiss camera lucida drawings from hand sections, which, with the exception of that shown in FIG. 5, were taken transversely through the stem. In some cases, as noted, the sections were stained to bring out the structures more clearly.

FIG. 1. Section through the hypoderm and epidermis of stem of an *Opuntia versicolor* plant, stained with Bismark brown, × 730. *a*, epidermis; *b*, outer layer of hypodermal cells, filled with calcium oxalate crystals; *c*, stomatal opening, leading down through hypodermal cells to cortical tissue; *d*, hypodermal cells; *e*, cortical tissue.

FIG. 2. Section taken near the periphery of a three-day-old wound in an *Opuntia versicolor* plant, × 245. *a*, cells bordering on wound surface which have retained their starch content; *b*, outermost portion of starchless layer, which has become somewhat discolored; *c*, cells which will later divide, and so form the first wound-meristem; *d*, inner portion of starchless layer.

FIG. 3. Section from near the periphery of a seven-day-old wound in an *Opuntia versicolor* plant, × 390. *a*, starchless cells, with lignified walls; *b*, starchless cells, the walls of which give test for both lignin and suberin; *c*, suberized-walled cells, which have arisen through the activity of the first wound-meristem; *d*, first wound-meristem; *e*, "phelloderm" tissue, produced by first wound-meristem; *f*, starchless cortical cells.

FIG. 4. Section through a twenty-four-day-old wound of an *Opuntia versicolor* plant, stained with Bismark brown, × 475. *a*, starchless cells, with lignified walls; *b*, outermost mass of suberized walled cells, produced through activity of first wound-meristem; *c*, lignified-walled cells, produced by first wound-meristem; *d*, inner mass of suberized-walled cells, produced through activity of first wound-meristem; *e*, first wound-meristem; *f*, "phelloderm" cells, produced by first wound-meristem.

FIG. 5. Transverse optical section of lignified-walled cells, produced through activity of first wound-meristem, stained with phloroglucin and hydrochloric acid, × 390. *a*, cell lumen; *b*, middle lamella.

FIG. 6. Portion of wound-periderm produced in an *Opuntia versicolor* plant, injured thirty-one days; all tissues shown have arisen from first wound meristem; stained with Bismark brown; × 475. *a*, outer mass of suberized thin-walled cells; *b*, outer mass of lignified thick-walled cells; *c*, middle mass of suberized thin-walled cells; *d*, inner mass of lignified thin-walled cells; *e*, inner mass of suberized thin-walled cells, arising from first wound-meristem (not shown).

The ferns and flowering plants of Nantucket—XIX

EUGENE P. BICKNELL

SUPPLEMENTARY NOTES

Ophioglossum vulgatum L. Abundant in a meadow near the Polpis schoolhouse, June, 1909, and in a Madequet meadow, July, 1912. New stations of only a few plants are in Squam and Shawkemo, in the shade of thickets, and by a pool on the Nantucket golf links.

Osmunda spectabilis Willd. Of luxuriant growth among wet thickets in Squam.

Osmunda Claytoniana L. When mentioning Clayton's Fern in Part I of this series no other evidence of its occurrence on Nantucket could be added to Mrs. Owen's record of a single specimen long ago found by Mr. Dame. Later exploration has discovered it in the present-day flora of the island. A single tuft in a meadow near the Creeks, observed first in 1908, was still there in 1912, when, also, a thriving colony was met with in a thicket in Squam. One tuft seen on Tuckernuck, June 17, 1911.

Asplenium Filix-foemina (L.) Bernh. Common locally, especially in Squam. The largest examples, in a Quaise thicket, were over three feet in length and fourteen inches in maximum width.

Two different kinds of lady ferns grow near together at Watt's Run, one green throughout, and having small fronds with close set, merely pinnate divisions, the other, characterized especially by a red-purple rachis, having broader fronds with less crowded pinnae and more deeply cut pinnules. This red-stalked plant, which I have long thought to be a distinct species, is common enough among the forms combined under this fern, but I have not seen it elsewhere on Nantucket.

It has recently been shown by Dr. F. K. Butlers (Taxonomic and geographic studies in North American ferns. Rhodora **19**: 179–216. *pl. 123*. S 1917) that, "in the eastern parts of North

America there are two species of the lady fern group which appear to be amply distinct from each other and from the true *Athyrium Filix-femina* [of Europe]. These are *A. asplenoides* (Michx.) Desv. and *A. angustum* (Willd.) Presl." In accordance with the indications of this paper the common Nantucket plant should bear the name *Athyrium angustum*. The large form that I have mentioned answers to var. *elatius* (Link) Butters, and the red-stalked form to var. *rubellum* (Gilbert) Butters. *Athyrium asplenioides* seems not to have been found on Nantucket, although it is cited by Mr. Butters from Sandwich, Massachusetts, and from Block Island.

Dennstaedtia punctilobula (Michx.) Moore. Abundant in dryish open places in parts of Trot's Swamp.

Equisetum arvense L. Proves to be well distributed, and is abundant in many localities.

Lycopodium obscurum L. Additional stations are Taupawshas swamp and south of the Fair Grounds, well-fruited at both places.

Lycopodium complanatum L. The Nantucket plant is the var. *flabelliforme* Fernald. Localities on the eastern side of the island are in Squam, where it fruits abundantly, near Sachacha Pond, Pout Ponds, Shawkemo.

Lycopodium tristachyum Pursh. In great abundance in the pine barrens towards the South Pasture, where it fruits prolifically, the peduncles sometimes bearing seven spikes.

Pinus rigida Mill. Observed on the north side of Tuckernuck Island, June 17, 1911, a few scattered trees, none of them over five feet high.

Larix decidua Mill. In 1911 the tallest trees were estimated to be perhaps twenty feet in height.

Juniperus virginiana L. The tallest red cedars are found scattered through the oak woods in Coskaty, and probably exceed twenty feet. Among the extensive growth of red cedars on Coatue bright green and blue glaucous forms are everywhere grouped together in agreeable contrast. On July 13, 1912, both were well fruited, the blue form being the more prolific.

Typha angustifolia L. Under this name are two rather distinct

appearing cat-tails that seem to call for critical study. One is the abundant species of our coastwise marshes, the other a scarcer and much more slender and narrower-leaved plant perhaps exclusively of fresh water bogs. A comparison of living plants, in July, 1912, showed a very obvious difference in their general coloring, the narrower-leaved plant quite wanting the bluish tinge of leaf and stem so characteristic of the other; the leaves were also more attenuate, and considerably longer at the time the plants were beginning to bloom, and the very slender spikes were separated by an unusually wide interval. Less obvious differences were the more striate stem of the smaller plant and the absence from its cortex of the numerous pale puncticulae that, under a lens, appeared distinctly in the contrasted form. On July 1 the slender plant was just in flower, the broader-leaved form somewhat more advanced. *Typha latifolia* was not seen in flower until July 10.

Sparganium eurycarpum Engelm. Much earlier flowering than the other island species; fruiting heads are of full size sometimes as early as the third week in June. *S. americanum* had no mature staminate flowers up to July 12, 1912.

Potamogeton Oakesianus Robbins. Flowering and fruiting abundantly in June.

Potamogeton pulcher Tuckerm. Flowering abundantly, sometimes before the end of May. As early as June 5, 1911, it was blooming freely and bore well-formed fruit, while yet the leaves were far from maturity, even the uppermost retaining their early tenderness and pinkish-brown color.

Potamogeton pectinatus L. In full flower and with immature fruit as early as June 10, 1908.

Ruppia maritima L. Professors Fernald and Wiegand, in their paper, "The genus *Ruppia* in eastern North America" (Rhodora **16**: 119–127. *pl. 110.* 1914), have referred the Nantucket plant to var. *longipes* Hagström, citing and figuring a specimen collected in Sachacha Pond by Professor F. S. Collins. Specimens of this form collected in Sachacha Pond, June 12, 1911, were in full flower. It is quite possible that plants observed in a ditch on

Swain's Neck, only just in flower September 17, 1907, were of a different form.

Zanichellia palustris L. Fresh water ditches in Shawaukemmo Spring meadow; abundant in a salt creek on Little Neck, where it was flowering and fruiting freely June 22, 1910. At both stations the plants appeared to be perfectly typical of var. *pedunculata* J. Gay, the peduncles becoming 1–3 mm. long and bearing stipitate nutlets; these were denticulate, and margined along the dorsal ridge by a narrow semi-transparent membranous expansion.

Naias flexilis (Willd.) Rostk. & Schmidt. A second station is Hummock Pond where it was collected by Miss Gardner, September 12, 1915.

Naias guadalupensis (Spreng.) Morong. In Hummock Pond, the third Nantucket pond in which it is now known to occur.

Triglochin maritima L. In flower as early as May 30, 1909; some plants still in bloom July 10, 1912.

Alisma subcordatum Raf. Pool north of the town, 1908; pool not far from the original station, 1912.

Sagittaria Engelmanniana J. G. Sm. In early flower July 10, 1912.

Sagittaria latifolia Willd. A large form occurs at No-Bottom Pond having the leaf blades and their basal lobes narrowly elongated and tapering, sometimes becoming over 20 cm. in length while only 10 mm. wide at the base.

Panicum linearifolium Scribn. True *P. linearifolium* has not been collected on Nantucket. The grass somewhat intermediate between it and *P. depauperatum*, previously referred, with reservations, to *P. linearifolium*, has been determined by Professor Hitchcock to be the variety of *P. depauperatum* mentioned by Hitchcock and Chase in North American species of *Panicum* (Contr. U. S. Nat. Herb. **15**. 1910), p. 152.

Panicum Owenae Bicknell. A fully developed mature tuft, collected July 1, 1912, well attests the distinctness of this grass from *P. Addisonii* Nash, to which less perfect examples were referred by Hitchcock and Chase (North American species of

Panicum, p. 243). It has now been collected at four stations scattered within a distance of little more than a mile north and west of the town. At each station only a single tuft was found, or a few together, growing in association with *P. depauperatum* and *P. meridionale*. In many of its characters *P. Owenae* is somewhat intermediate between these abundant Nantucket grasses and, although they belong to rather distinct groups in their genus, the possibility seems to appear that *P. Owenae* may be a hybrid between them. *P. Owenae* has been figured in Britton and Brown's Illustrated Flora from a specimen collected June 20, 1908.

Panicum Bicknellii Nash. Collected a second time on Nantucket, June 17, 1911, on the downs east of Long Pond.

Panicum dichotomum L. Additional localities are in Siasconset and Squam and near Sachacha Pond.

Panicum tennesseense Ashe. This proves to be rather a common species on Nantucket.

Chaetochloa versicolor Bicknell. A restudy of this grass has not enabled me to view it as being the same as *C. imberbis perennis* (Hall) Scrib. (*C. occidentalis* Nash) to which it has been referred. Nor does its obviously closer relationship to true *C. imberbis* establish identity with that species. Although it is said to intergrade with *C. imberbis*, I have yet to see specimens of mature plants that cannot readily be separated.

Stipa avenacea L. Quite unexpectedly this grass has proved to be a characteristic species of Nantucket occurring, however, mainly on the eastern side of the island where it is well distributed and locally abundant. It is found in scrub oak barrens along the railroad and towards Siasconset and Sankaty Head, and in Wauwinet, Pocomo and Quaise; it is also common on the Smooth Hummocks on the western side of the island, and was observed on Tuckernuck. It is locally common on Chappaquiddick Island. Inflorescence appearing June 9, 1909; just in flower June 15, 1911, June 24, 1910.

Alopecurus geniculatus L. Stations distant from the town are Quidnet and Millbrook swamp.

Aira caryophyllea L. In full flower June 5, 1910, the larger

plants 7 cm. high, but many not over 1 cm. and bearing only a terminal spikelet. These diminutive plants were massed so thickly over damp sandy tracts as to have the appearance of beds of flowering moss.

Poa pratensis L. A variety that grows in sandy soil, often in pure sand, is low and pale glaucous green, with firm culms and contracted purple panicles, the leaves often slightly pubescent on the upper surface and on the sheaths. In such forms the middle and marginal veins of the palea were found to be more bearded than in the ordinary pasture form.

Panicularia grandis (S. Wats.) Nash. *P. americana* (Torr.) MacM. Of luxuriant growth about Millbrook swamp and along ditches west of the town.

Panicularia acutiflora (Torr.) Kuntze. Millbrook swamp; head of Hummock Pond; Polpis; Quidnet.

Panicularia pallida (Torr.) Kuntze. A reduced form, abundant in Rotten Pumpkin Pond, June 11, 1911, seemed to answer quite exactly to descriptions of var. *Fernaldii* Hitchc., but were regarded by Professor Hitchcock, to whom specimens were submitted, as being scarcely typical. In a recent paper on the "Status of *Glyceria Fernaldii*" (Rhodora **19**: 75–76. 1917) Dr. Harold St. John has placed this grass in specific rank under the generic name *Glyceria*, marking it off sharply from *P. pallida* by certain characters hitherto unnoticed, among which very small anthers and reflexed lower branches of the panicle seem especially noteworthy. By the test of these characters the Nantucket plant is definitely excluded from *G. Fernaldii*, its anthers, even in the dried state measuring as much as 1–1.5 mm. long, and all the panicle branches remaining flexuously ascending or erect. In other respects, however, such as narrow leaves and small few-flowered spikelets its agreement with *G. Fernaldii* seems to be quite perfect.

On Long Island the problem is even more confused. Some Long Island specimens appear to have all the characters of *G. Fernaldii* except reflexed panicle branches; other equally small-anthered forms are as broad leaved as typical *P. pallida;* in yet others the size of the anthers is half way between the two extremes. It sometimes occurs that summer rains following a drought will

revive a growth of *P. pallida* in drying pond holes where it had earlier flowered as an aquatic, not infrequently bringing it to a second flowering period, and it is to be noted that this interruption of its course of growth has a repressive influence, sometimes very obvious, both on the plant as a whole and in its parts. Nevertheless between *P. pallida* and authentic *G. Fernaldii* there is a certain difference of aspect not readily definable and this, together with the differing distribution of each as worked out by Dr. St. John, may well point to something in their diversity more fundamental than a mere response to casual changes in the conditions that immediately affect growth.

Puccinellia distans (L.) Parl. At the only station for this grass known to me on Nantucket, where it is in abundance, well-developed plants possess all the characters of typical *P. distans* as defined by Fernald (Rhodora **18**: 12–13. 1916), while reduced examples, these the more numerous, correspond perfectly to the description of var. *tenuis* (Uechtritz) Fernald; intermediate forms grow with the extremes.

Festuca octoflora Walt. Not uncommon, and rather widely distributed: near the Cliff; Island View farm; Tom Never's Swamp; Madequet.

Festuca myuros L. Widely scattered and growing in close abundance at many places.

Festuca capillata Lam. Common and well distributed, even far out on the plains and commons.

Festuca ovina L. Abundant and widespread in dry sandy soils.

Bromus tectorum L. Up to 1908 this grass had become established only sparingly, although growing freely on the low dunes near the bathing beach and observed at stations as far east as Polpis and Pocomo and west towards Madequet. In succeeding years it was found to be spreading freely and fast becoming common.

Bromus hordeaceus L. The prevailing grass in many lots and fields.

Bromus secalinus L. Observed only at two stations in the town and in waste ground near Surfside.

Hordeum jubatum L. Reported by Mrs. Flynn as having been found by her as early as 1895. Collected at Siasconset, September 14, 1915, by Miss Gardner.

Hordeum vulgare L. Awned and awnless forms are frequent in old fields.

Eleocharis tricostata Torr. Almanac Pond remains the only known station on Nantucket for this spike rush. It was in early flower there June 11, 1912.

Scirpus validus Vahl. Less infrequent than at first appeared. Additional stations are: head of hummock Pond; Squam Pond; South Shore ponds; Coatue.

Carex hirta L. A second station is in a damp lot back of the Springfield House, where it was well established June 11, 1911.

Carex stricta Lam. Additional localities are near Long Pond and in a bog on Little Neck.

Carex virescens Muhl. At Beechwood, in woodland shade, occurs a taller form, dark green, with much reddened sheaths and narrow spikes, liable to be mistaken for *C. costellata* Britton. This is not an uncommon form in shaded woodland, and furnishes examples, such as I referred to in Part III of this series, that correspond accurately with Schkuhr's original illustration of this species.

Carex leptalea Wahl. Additional localities are Shawankemmo meadow, Sachacha Pond, Little Neck bog.

Carex muricata L. Found as far from the town as beyond the water works, at Tristram Coffin's monument around the base of the shaft, south of the Thorn lot and east of Island Home.

Carex incomperta Bicknell. A second station is a boggy place near Monomoy, about one and one half miles from the type locality—June 28, 1912.

Carex Howei Mackenzie, Bull. Torrey Club **37**: 245. 1910. Mr. Mackenzie has thus renamed this distinct sedge, the name *C. delicatula*, given to it in Part III of this series, having been preoccupied by its employment earlier the same year by C. B. Clarke in the Kew Bulletin.

Arisaema pusillum (Peck) Nash. On Nantucket extremes of this plant are at marked contrast. At Watt's Run and in Trot's Swamp the smallest and most delicate form, with narrow black-purple spathes and slender linear spadix, may be seen growing near by much larger examples having broader, striped, or even wholly green spathes and with the spadix sometimes slightly clavate. In some plants the spathe is fluted or ribbed on the inner as well as the outer side. Observed in flower from June 1 to July 4.

Lemna minor L. Sachacha Pond; Shawkemo; Capaum Pond.

Lemna trisulca L. Choking the ditches in meadows north of the town, and in great masses floating and submerged in No-Bottom Pond.

Tradescantia virginiana L. Scattered through a sandy lot on the north side of the town; also a large tuft in a grassy opening in pine woods south of the Fair grounds, June, 1910.

Juncus balticus Willd. At several localities in Shawkemo growing in abundance along the borders of fresh water bogs near the shore as well as in brackish soil.

Lilium philadelphicum L. Leaves commonly very narrow and often somewhat scattered, suggesting an approach to *L. umbellatum* Pursh; but the capsules, although often attenuate at base, are very variable in size and form and are mostly obovoid or obovoid-oblong.

Vagnera stellata (L.) Morong. Additional localities are Trot's swamp, where it is locally common, and Thorn lot, Shawkemo. Small plants growing on the open plains near the South Shore have the later leaves perfectly glabrous beneath.

Polygonatum biflorum (Walt.) Ell. *Salomonia biflora* Farwell. To be regarded as not uncommon rather than scarce or local, but not met with on the western side of the island.

Medeola virginiana L. Restricted to the same parts of the island as the preceding and mainly to the same thickets, in some of which, especially in Shawkemo, it is a frequent plant.

Smilax herbacea L. Not infrequent, extending from the localities previously reported into Pocomo.

Hypoxis hirsuta (L.) Coville. A second station is near Long Pond where a solitary flowering plant was found June 1, 1909.

Gymnadeniopsis clavellata (Michx.) Rydb. A second station, for this orchid is "'near the Cliff, 1888,' Miss Mary Foster Coffin and Leroy Schumacher," *F. G. Floyd.*

Blephariglottis ciliaris (L.) Rydb. "'Not far from the first station, about twenty-five plants, 1897,' Lorin L. Dame," *F. G. Floyd.*

Liparis Loeselii (L.) Richard. "'Near the Cliff, one plant, 1888, and Monomoy, about a dozen plants, 1891,' Miss Mary Foster Coffin," *F. G. Floyd.*

Salix tristis Ait. On the north side of the island observed only near Capaum Pond, a single patch.

Salix petiolaris Sm. A second locality is Trot's Swamp, 1910.

SALIX BEBBIANA × CINEREA? A willow collected in Tom Never's swamp, June 3, 1908, growing with other willows, including the tree of *Salix cinerea* that is established there, and also *Salix Bebbiana*, quite unmistakably, I think, shows in combination leaf and branch characters of both these species as well as other evidences of being a hybrid.

Another ambiguous willow collected near Gibbs' Pond, September 19, 1899, is strongly suggestive of a cross between *Salix eriocephala* and *S. Smithiana*, both in the shape of the leaves and their dense velvety pubescence.

Myrica Gale L. A second station is by a tidal pond near Abraham's Point where a thick cluster six feet across and three feet in height was observed June 7, 1911, no specimens being taken. In specimens collected at the Capaum Pond station, September 12, 1907, the leaves are either wholly glabrous beneath or with some obscure pubescence on the midrib near the base. But specimens in the herbarium of Miss Gardner collected at the same station, August 21, 1915, are more or less evidently pubescent on the lower surface. I do not know, therefore, whether an exact determination of the Nantucket plant would place it with the typical form of the species or with var. *subglabra* (Chevalier) Fernald (Rhodora **16**: 167. 1914).

Myrica carolinensis Mill. At Coskaty twelve to fourteen feet high, the stoutest trunk thirteen inches in circumference; a somewhat lower shrub near Abraham's Point was fourteen inches in girth of trunk.

Hicoria alba (L.) Britton. A wide-spreading tree in a Shawkemo thicket, in 1909, was about twelve feet in height and thirty-one inches around the trunk; the lower branches descended to the ground and in their widest reach overspread a space paced at forty feet.

Hicoria glabra (Mill.) Britton. The stump of a tree in Shawkemo, recently felled in 1901, measured thirty-seven inches in circumference.

Hicoria microcarpa (Nutt.) Britton. Not far from the tree at Wauwinet previously reported is a group of three trees discovered June 10, 1911, the largest of which, about fifteen feet in height, had a maximum trunk circumference of twenty-six inches and a spread of branches close to the ground of not less than thirty-five feet.

Carpinus caroliniana Walt. "'Rare and shrublike, 1901,' Lorin L. Dame," *F. G. Floyd.*

Betula populifolia Marsh. The largest trees seen grew among pines near the Wauwinet road and, in 1911, were estimated to be eighteen feet in height.

Fagus grandifolia Ehrh. Undoubtedly the largest of our forest trees growing on Nantucket today are beeches. The tallest are in Beechwood and must be fully thirty-five feet in height. The stoutest trunks seen there were, one fifty inches, another forty-four inches in girth near the base. A much stouter tree in Squam, difficult of access through its encompassment of dense thickets, although not over twenty feet in height, measured seventy-three inches in circumference one foot above the base.

Quercus coccinea Muench. Native trees occur at Coskaty, the largest twenty-five to thirty feet in height, by estimate, the stoutest trunk forty-one inches around one foot above the base.

Quercus velutina Lam. The stoutest black oak seen on Nan-

tucket, in Squam, measured forty-two inches in maximum girth. But much stouter trees grow on Tuckernuck where trunks were measured forty-seven and fifty inches and one sixty-eight inches in circumference about one foot above the ground, decreasing to forty-five inches a span higher up.

Quercus stellata Wang. New stations are Acquidness Point, a close group of five trees, the largest eight feet high (1911) and near Wigwam Ponds, four scattered trees from four to seven feet high (1912).

Quercus pagodaefolia (Elliot) Ashe. On June 9, 1911, the oak tree discussed in Part IV under this name was found to be dead, but a second and perfectly healthy tree of about the same height, and twenty-five inches in girth of trunk near the base, was discovered not far off in the same thicket. Some old acorn cups found beneath the tree are saucer-shaped to hemispheric, some of then contracted to a short scaly base, 1.5–3 cm. wide, the slightly tomentulose scales closely imbricated to a firm margin, the individual scales contracted to a lanceolate obtuse termination. A few partly decayed nuts were ovoid-globose, the exposed portion apparently about one half their length.

Quercus ilicifolia Wang. Two forms of the bear oak differing markedly in leaf pattern are common on Nantucket. In characteristic form the leaf of this oak has short lobes of more or less triangular general outline. In the variant the lobes of the leaves are narrower and more tapering, becoming lanceolate or even somewhat falcate, the sinuses cut much nearer to the midrib and the terminal lobe often elongated after the manner of *Q. falcata* Michx. Some leaves indeed are strikingly similar to those of that species. The two forms of leaf present extremes of divergence that are very noteworthy and suggest an interesting subject for critical study.

Quercus rufescens (Rehder) sp. nov.

Quercus prinoides var. *rufescens* Rehder, Rhodora **9**: 60. 1907.

This scrub oak proves to maintain so notable a constancy in its characters and is so readily recognizable that, as a result of field observations both on Nantucket and on Long Island I have come

to accept it as essentially distinct from *Q. prinoides;* nor have I yet encountered any trees so nearly intermediate between the two as to have the appearance of being hybrids.

It may be noted that the anthers of *Q. rufescens* are perceptibly smaller on relatively shorter filaments than those of *Q. prinoides*, that is to say this proved to be true in numerous cases when I was enabled to make satisfactory comparison in the field.

QUERCUS ALBA × RUFESCENS? An oak about five feet high of somewhat straggling form, observed near the Wigwam Ponds, July 6, 1912, conveyed a strong impression of being a hybrid between *Q. alba* and *Q. rufescens*. The pubescence of the leaves and branchlets is much as in *Q. rufescens*, while the size of the leaves, some of them 14 × 8 cm., and their deep lobing seem to point rather clearly to *Q. alba* as one of its parents.

QUERCUS ILICIFOLIA × VELUTINA Rehder. A thriving oak, a hybrid, there seems little reason to doubt, grows in the dense thicket on the western side of Dyleave Swamp. It was about twelve feet in height and nineteen inches in girth low on the trunk June 26, 1910. In its foliage it is very distinct from any other Nantucket oak that I have seen, and the forms of its leaves and their pubescence suggest, rather convincingly, I think, a mixed origin from the two oaks above indicated as probable parents. Such a hybrid was described and figured by Mr. Rehder (Rhodora 3: 137. *pl. 24.* 1901). The leaves of the Nantucket tree show remarkable variation in form, and have no close similarity to those figured by Mr. Rehder, but the pattern characters by which they differ appear to be such as might well result from a crossing of *Q. velutina* with the form of *Q. ilicifolia* having narrow deeply cut leaf lobes rather than with the more usual short-lobed form. They are, however, considerably larger than those which Mr. Rehder has described, the largest being 17 × 14 cm. When young the lower surface is whitened with a close tomentulose pubescence, although in less degree than those of *Q. ilicifolia*, but this is impermanent, the leaves becoming quite green beneath in age. The cups of some old acorns found beneath the tree were turbinate, their scales tomentulose to partly glabrate; nuts conic ovoid or oblong, 10–14 mm. long, tomentulose and strigose towards the apex.

QUERCUS COCCINEA × VELUTINA? Ambiguous trees at Coskaty growing with *Q. coccinea* and *Q. velutina* are difficult to understand except as hybrids of those species.

Quercus palustris Muench. Besides the introduced pin oaks still persisting in the Thorn lot, a few scattered trees, the largest eight to ten feet in height, were observed among the Miacomet pines in 1909, and a single tree among pines south of the fair grounds in 1910. The latter had the appearance of being adventive.

Quercus bicolor Willd. Some small trees persist in the Thorn lot among the other introduced oaks previously reported as growing there.

Humulus Lupulus L. Localities far from cultivated ground where the hop has every appearance of being indigenous are Trot's swamp; west side of Long Pond; Swamp in Madequet, where there is much of it.

Cannabis sativa L. Prospect Hill, herbarium of Miss Gardner; Pleasant Street, Mrs. Flynn.

Rumex crispus L. Plants with the grain short and rounded seem to be less common than those with attenuate and acute grain (*Rumex elongatus* Guss.); the character, however, seems to be inconstant and even varies much in the same plant.

Rumex persicarioides L. Dr. Harold St. John, who has revised our former understanding of this species (Rhodora **17**: 73–83. *pl. 113, f. 34.* 1915), considers that the Nantucket plant should stand as *Rumex maritimus* var. *fueginus* (Phil.) Dusén.

Polygonum maritimum L. Professor Fernald has convincingly shown that our plant is distinct from the European *P. maritimum* and should bear the name *Polygonum glaucum* Nutt. (Rhodora **15**: 68–73. 1913).

Persicaria pensylvanica (L.) Small. Two varieties of this common plant have recently been recognized by Professor Fernald (Rhodora **19**: 70–73. 1917). The prevailing Nantucket form, described in Part V of this series, is *Polygonum pensylvanicum* var. *nesophilum* Fernald. The closely related var. *laevigatum* Fer-

nald also occurs on Nantucket as well as the more distinct type form of the species, which is scarce.

Agrostemma Githago L. Occasional in fields and waste places.

Dianthus Armeria L. In abundance by the railroad near the town; on the Cliff; near the waterworks.

Alsine graminea (L.) Britton. Old cartway over the commons east of the town, June 14, 1911; north of the town, June, 1912.

Castalia odorata (Ait.) Woodville & Wood. In Wigwam Pond, July 7, 1912, some leaves were as large as twelve and one half inches long and wide.

Liriodendron Tulipifera L. Mr. Floyd has sent me a note that young tulip trees were found by Mr. Dame in 1901 "growing freely in the Thornlot." Had any of these trees long survived it would seem that other collectors would have since observed them.

Coptis trifolia (L.) Salisb. Bloomingdale Swamp, June 17, 1914, collected by Mrs. G. A. Spear; specimen examined by me in Miss Gardner's herbarium. It is a matter of much satisfaction that the gold thread is thus definitely established as a Nantucket plant. It had been admitted in its place in this catalogue because included in Mrs. Owen's list, and also reported to me as having been found in the Thorn lot, but it has since appeared that both of these records are open to serious doubt. In a letter to Mr. Floyd under date of August 21, 1911, Mrs. Owen wrote, "I find no authority for *Coptis* on Nantucket," adding that she could not understand how the name got into the original Godfrey list. "When I was compiling my 'Flora of Nantucket,'" she stated further, "I probably used that printed list and took without question what I found there." The Thorn lot report I feel sure should be regarded as an error involved in some way with the trifoliolate-leaved *Rubus hispidus*, an abundant plant in that locality.

Actaea rubra (Ait.) Willd. In dense thickets eastward from the locality previously reported as far as Beechwood. Much scarlet fruit June 26, 1912.

Ranunculus repens L. Abundant all over the island, mainly in low grounds.

Thalictrum polygamum Muhl. Previously admitted because of Mrs. Owen's record on the authority of Mr. Dame. The discovery that *Thalictrum dasycarpum* Fisch. & Lall. occurs on Nantucket now makes necessary a substantiation of this record.

Sassafras Sassafras (L.) Karst. Trees as high as twelve to fifteen feet were seen in Shawkemo and Quaise, and in Squam one not less than eighteen feet, its trunk twenty-three and one quarter inches in circumference one foot above the ground.

Radicula palustris (L.) Moench. Waste ground north of the town, June 9, 1911, a group of plants just in flower; bog near Oldest House, August 18, 1915, herb. Grace Brown Gardner.

Erysimum cheiranthoides L. Recently collected by Miss Gardner on the Cliff road, a second station for Nantucket.

Conringia orientalis (L.) Dumort. Yard on North Water Street, June 17, 1911, one well-fruited plant; waste ground at Surfside, July 9, 1912, several fruiting plants and one just in bloom.

Reseda lutea L. A few plants in a field near Island Home, just in flower June 14, 1911; Fay farm, Squam, July 11, 1912, in flower and fruit. The original station in Polpis mentioned by Mrs. Owen was visited by Mr. Floyd in 1895; some plants were still growing there "although subjected to occasional mowing."

Drosera rotundifolia L. Racemes of buds but no open flowers, July 6, 1912. On Martha's Vineyard belated flowers of this sundew, as of the next, persist into September.

Drosera intermedia Hayne. *D. longifolia* L. in part. First flowers July 9, 1912.

Drosera filiformis Raf. Not yet in flower July 2, 1912.

Rosa cinnamomea L. Here and there by fieldsides and fence borders in the suburbs.

Amelanchier nantucketensis Bicknell. Further observation of this shadbush, later in the summer than I had previously studied it, show that the fruit ripens early in July, when it is red or purple in color, later becoming deep purple blue. By the middle of the month the shrubs, sometimes even those of the smallest size, may be seen thickly ornamented with the glaucous fruit in all stages of

maturity and varying in color from white through pink and red to purple all in the same cluster, producing a variegated and very pleasing color effect.

It has been suggested by Professor Wiegand in a paper entitled, "The genus *Amelanchier* in eastern North America" (Rhodora **14**: 117–161. *pl. 95, 96.* 1912) that this Nantucket shrub is a hybrid between *A. oblongifolia* and a proposed new species, named by him *A. stolonifera.* This theory, I think, scarcely takes sufficiently into account that *A. nantucketensis* is one of Nantucket's characteristic shrubs, more numerous indeed, and more generally distributed than the other shadbushes of the island, and also bearing fruit more abundantly and with greater regularity season by season. In Professor Wiegand's description of his *A. stolonifera* there seems to be little to differentiate it from *A. nantucketensis* beyond larger petals, a variable character, I find, in *A. nantucketensis*, and densely woolly summit of the ovary. In *A. nantucketensis* the exposed surface of the ovary is, as I have described it, nearly or quite glabrous; this is its condition at maturity, in its earlier stages it is clothed with a white woolly pubescence. Its close relationship to Professor Wiegand's new species is also to be inferred from its having been attributed to Nantucket on the basis of Miss Day's collection, No. 95, June, 1900, a sheet of which in the herbarium of the New York Botanical Garden formed part of the material used in formulating my description of *A. nantucketensis.* This specimen is the counterpart of numerous specimens of my own collecting, and was not cited only for the reason that the species was so abundant on Nantucket that no need appeared of any citation of specimens other than the type and co-type.

Crataegus chrysocarpa Ashe. A group of four shrubs, June 29, 1912, about two miles west of the original station.

Prunus maritima Wang. I do not know that the yellow or amber fruited form of the beach plum has ever been found on Nantucket. I was told that it occurred on Tuckernuck and it is locally abundant on Chappaquiddick Island and in other parts of Martha's Vineyard. It is not generally disseminated and is evidently scarce elsewhere than in the localities where it abounds. I have myself seen little of it except as gathered by the islanders

who, in collecting it, are accustomed to keep it separate from the purple form for use, I was told, in making a light-colored jelly. On September 16, 1913, a group of plum gatherers returning across Chappaquiddick Island were laden with baskets of these plums, as many filled with the amber fruit as with the purple. I have likewise seen large sacks of the amber plums at Edgartown which, it was said, had been brought in from Chilmark. No constant difference in size or form between the yellow and purple fruit could be discovered, but on Chappaquiddick I observed a particular bush of the yellow-fruited form on which the plums were of unusually large size and ovoid rather than globose. The yellow fruit is somewhat translucent, and varies in color from amber to light yellow and pale orange.

Laburnum vulgare Gris. Several well-grown trees of the laburnum are scattered in partly open ground among the pines near Miacomet Pond, where they were in full bloom June 11, 1911.

Erodium cicutarium (L.) L'Hér. "A well-established colony of about twenty plants in a field near the Thorn lot," in flower and fruit, September 15, 1915; specimens in the herbarium of Miss Grace Brown Gardner. Not reported as growing in Nantucket since 1851.

Linum striatum Walt. Collected by Miss Gardner at Hummock Pond, September 12, 1915, the second known station on Nantucket.

Cicuta bulbifera L. Collected by Miss Gardner, September, 1915, at the original station discovered in 1899 by Mrs. Flynn.

Arctostaphylos Uva-ursi (L.) Spreng. Mr. Floyd writes me that he has occasionally observed on the commons a form with crimson flowers, and that Mrs. Owen had told him that this crimson-flowered bearberry had been familiar to her for many years.

AMSINCKIA ARENARIA Suksd. A recent paper by Dr. J. Francis Macbride (A Revision of the North American Species of *Amsinckia*, Contr. Gray Herb. 49. 1917) makes clear that the plant reported in Part XIV of this series as *A. intermedia* F. & M. is not that species. Specimens have been submitted to Dr.

Macbride who considers them referable, perhaps not without some uncertainty, to *A. arenaria* Suksd. of the northwest.

Thymus Serpyllum L. Law nor Sankaty Bluff, August 28, 1915, Miss Gardner.

Setiscapella subulata (L.) Barnhart. Peat bog between Polpis and Quidnet, 1915, Miss Gardner.

Houstonia caerulea L. Miss Alice O. Albertson has sent me an interesting specimen of this species collected on the Nantucket golf course, May 13, 1916. It is matted and subspreading, the stems and long peduncles relatively stout, and the flowers large, spreading 1.5 cm. in the pressed plant; the calyx lobes are oblong to obovate-oblong and more or less foliaceous, becoming 1.5 mm. or more wide, with somewhat spreading tips, and equalling the short and broad tube of the corolla in the single specimen seen.

Viburnum venosum Britton. The largest example seen, Rattlesnake bank, June 8, 1911, was of the stature of a small tree, the trunk eleven inches in girth near the base.

Lactuca virosa L. Collected by Miss Gardner in the town, August 24, 1915, a second station on Nantucket for this intruding weed, and too probably an indication that it is becoming established there.

ADDENDUM

Under *Sabbatia campanulata* in Part XIV of this series read, on page 32, *S. stellaris* for *S. campanulata*.

The following two plants, new to Nantucket, have recently come to light in a collection of specimens kindly sent to me by Mrs. Flynn:

*HELIANTHUS PETIOLARIS Nutt. Old field near Windmill, August 5, 1911, collected by Mrs. Nellie F. Flynn.

*KOELLIA INCANA (L.) Kuntze. Collected by Miss Mina K. Goddard, August 17, 1895. Locality not mentioned. The species is an interesting addition to the native flora of Nantucket. Mrs. Flynn, who has recently made inquiries in regard to this specimen, writes me that Miss Goddard believes it was probably found at Wauwinet where, as disclosed by her records, she collected plants on the very date that appeared on the specimen label.

INDEX TO AMERICAN BOTANICAL LITERATURE

1902-1918

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card issue should be addressed to the Treasurer of the Torrey Botanical Club.

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Abrams, L. R. A phytogeographic and taxonomic study of the southern California trees and shrubs. Bull. N. Y. Bot. Gard. **6**: 300–485. *pl. a–j.* 27 S 1910.

Includes *Lupinus Brittoni*, *Amorpha occidentalis*, *Ceanothus austro-montanus*, and *Malacothamnus Nuttallii*, spp. nov.

Arthur, J. C., & Johnston, J. R. Uredinales of Cuba. Mem. Torrey Club **17**: 97–175. 10 Je 1918. [Illust.]

Includes new species in *Cronartium* (1), *Cionothrix* (1), *Ravenelia* (1), *Uromycladium* (1), *Puccinia* (3), *Aecidium* (2), and *Uredo* (3).

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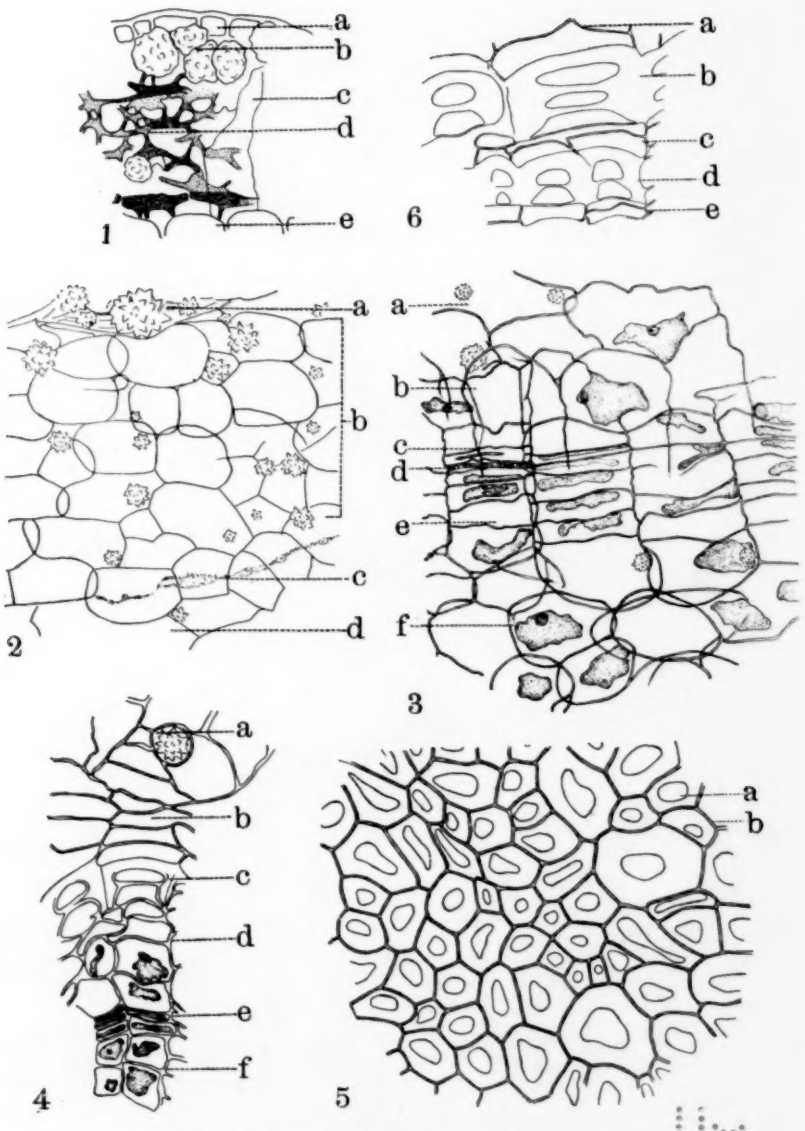

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